DOCUMENT RESUME

ED 074 752 EM 010 938

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TITLE The Effects of Pictures on the Acquisition of a Sight Vocabulary in Rural EMR Children.
INSTITUTION Florida State Univ., Tallahassee. Computer-Assisted Instruction Center.
SPONS AGENCY Florida State Dept. of Education, Tallahassee. Education for Exceptional Children Section.; Wakulla County Board of Public Instruction, Crawfordville, Fla.
PUB DATE Feb 73
NOTE 22p.; Paper presented at the American Educational Research Association Annual Meeting (New Orleans, Louisiana, February 25-March 1, 1973)

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS *Computer Assisted Instruction; Emotionally Disturbed Children; Low Ability Students; *Mentally Handicapped; *Pictorial Stimuli; Programed Instruction; Reading Instruction; Reading Research; Retarded Children; Retarded Readers; *Sight Vocabulary; Visual Learning; *Word Recognition

ABSTRACT

Utilizing a "shotgun" instructional approach with feedback, a linear instructional program, and an IBM 1500 computer system, this study investigated the effects of pictorial representations of words on the acquisition of a sight vocabulary by rural emotionally and mentally retard d (EMR) students. Twenty-seven students were involved in the study. The results clearly supported the hypothesis that pictures can aid in the acquisition of a sight vocabulary. Reading performance was measured by both the Gates-MacGinitie Primary Reading test and the Dolch Word-Recognition test. The program consisted of thirty lessons of nine simple words each. (MC)

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THE EFFECT OF PICTURES ON THE ACQUISITION OF A SIGHT VOCABULARY IN RURAL EMR CHILDREN

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February, 1973

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The Effects of Pictures on the Acquisition of a Sight Vocabulary in Rural EMR Children[1]

INTRODUCTION

A primary concern of educators is teaching children to read. One method of teaching initial reading skills is the look-and-say method. In this approach emphasis is placed on learning whole words and the development of a sight vocabulary. One of the techniques used in this approach is to pair pictures with words, thus encouraging the child to associate the meaning of the picture with the visual symbol presented (Mills, 1970). The purpose of the present study was to investigate whether pictures used in this way would facilitate the acquisition of a sight vocabulary, as adherents of this approach claim (Mills, 1970), and as some evidence from recall and recognition studies of pictorial vs. verbal material suggests (Paivio, 1966) or conversely, whether pictures would interfere with the acquisition of reading skills as others have argued (Samuels, 1970). An analysis of his research suggested that failure to demonstrate superior learning performance using pictures may be due either to a failure to control the attentional responses of the students, or confounding introduced by other extraneous variables. It was reasoned that if students could be caused to attend to the relevant pictorial as well as verbal material, acquisition of a sight vocabulary would be facilitated.

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[1]This research was conducted at the Center for Computer-Assisted Instruction and was funded by Title VI, State Department of Education, Exceptional Child Education and in cooperation with Wakulla County School System.

Pictures, Objects, and Words in Reading

Discussing the uses of automated instruction in reading, Stolurow (1960) suggested that pictures be used to elicit the correct response when a stimulus word is presented. He stated that one of the problems basic to initial reading is that of getting the student to associate meaning with orthographic stimuli. There is considerable evidence to suggest that this approach is feasible.

A study by Lieberman and Culpepper (1965) investigated the recall value of objects, pictures, and words. Two experiments were reported. In the first one, a number of small, easily identifiable objects were mounted on a board. Words matched for each object were placed in corresponding positions on an identical board. On an unlimited free recall task, objects were recalled correctly more often than were words and the differences were statistically significant. In the second experiment, pictures replaced the objects and again statistically significant differences favoring the recall of pictures were found.

A similar study was reported by Paivio (1966). Pictures and corresponding concrete nouns served as stimuli and response members of a paired-associate task. The Ss consisted of 84 college students. The results indicated that pictures used as responses to concrete noun stimuli were recalled better than noun stimuli paired with noun responses. Other investigators have supported the observation that pictures are remembered better than are words (Jenkins, Neale and Deno, 1967).

On the basis of these findings, it seemed reasonable to expect that using pictures in teaching a sight vocabulary should facilitate the association between the orthographic characteristics of a word and the meaning of the word.

Despite the apparent validity of this hypothesis, however, studies which have directly investigated the effectiveness of pictures in teaching a sight word vocabulary have yielded inconclusive evidence. Samuels (1970) reviewed the literature on reading and reported that of the 400 or so articles on reading in one year only a fraction of them questioned the fact that most reading materials at the early level use pictures. He conducted several studies which failed to support the hypothesis that pictures facilitate the recognition of a sight vocabulary. In an early study of the effects of pictures on learning to read words, Samuels (1967) presented first graders with picture-word stimuli in both a laboratory and a classroom environment. In the first experiment, 30 first grade students were presented with four words administered under no-picture, simple picture and complex picture conditions. The stimulus materials consisted of 5" by 8" cards, at the bottom of which the stimulus word was printed in primary type. In the picture conditions a simple or complex picture was placed above the stimulus word in the center of the card. Simple pictures were black and white line drawings, while the complex pictures were colorful and cut out of a primary reader. Ten acquisition and ten test trials were alternated, with no feedback during the test trials. The results indicated that while the picture groups were significantly superior (statistically) to the non-picture group during the acquisition trials, the non-picture group was

significantly better on the test trials. Samuels argued that the pictures distracted Ss attention from the words, which were the relevant stimuli. He pointed out that the problem at issue is that of stimulus control. In the studies cited, no controls have been used to direct Ss' attention to both the picture and the word; consequently, S could attend to either or both. The problem is to cause the student to attend to the word as well as to the picture, and to form an association between the two, such that the meaning of the picture becomes associated with the orthographic properties of the word.

In a curriculum development project currently in progress with EMR children in a rural county, it was found that while low level reading students could match words, they were unable to verbally identify or name the words (Brown & Luyben, 1972). It was apparent from talking with teachers, aides, and the children themselves that few connections had been made between the words as presented and their meanings. It was suggested that word-picture pairs be presented in an attempt to bridge the gap between word matching and word recognition. A computer-based instructional program was used in order to maximize control of the learning situation as well as to provide the unique instructional advantages that a computer-based system affords. Substantial evidence exists supporting the use of automated instruction with EMR students (Malpass et al, 1964; Blackman & Copobianco, 1965). Some of those advantages briefly stated include immediate feedback, sequencing, independence from the teacher, experimental control, data collection, and data handling. In view of the previous research in this area, it was felt that an individualized and programmed instructional sequence would reduce extraneous and

irrelevant variables which appear to have confounded previous investigations, and provide control over Ss attention to relevant stimuli.

In summary, the present study investigated the effects of pictorial representations of words on the acquisition of a sight vocabulary in a computer-based instructional system with rural EMR students.

Method

Subjects

Ss consisted of 27 EMR students in four special education classrooms in Wakulla County, northwest Florida. Thirteen Ss were randomly assigned to the word-word (W-W) matching group, while the remaining fourteen Ss were assigned to the word-picture (W-P) matching group. Characteristics of the sample are presented in Table 1.

Group	Total N	Boys		Girls		Mean Age	Mean Grade
		Black	White	Black	White		
W-W	13	3	3	2	5	9.75	3.8
W-P	14	6	3	2	3	9.28	3.5

Table 1.--Sample Characteristics

Pretest data on reading scores for the two groups is presented in Table 2.

Group	Reading Tests	
	Dolch	Gates-McGinitie
	Word Recognition (Percent Correct)	Vocabulary (Grade Level)
W-W	27.81%	1.61
W-P	17.27%	1.39

Table 2.--Reading Test Scores - Pretests

Design

The experimental design used, relevant to the pre- and posttests may best be described as a 2 factor design with repeated measures on the second factor. The first factor consisted of the two groups of Ss randomly assigned to word-word and word-picture matching tasks, while the second factor consisted of pre- and posttest reading scores. Interposed between the pre- and posttests was an instructional treatment block, which was analyzed separately and which can be described as a 2 x 3 x 2 x 5 x 2 factorial design with repeated measures on all but the first factor. A tabular arrangement of the design is presented in Table 3.

Levels of the RA factor indicate the number of response alternatives which are paired with each stimulus word in that group of 10 lessons. Levels RA 2, 3, and 4 indicate that 2, 3, and 4 response

TABLE 3.--Instructional Treatments Design

Group	NUMBER OF RESPONSE ALTERNATIVES (RA)																			
	RA 2				RA 3								RA 4							
	Initial Exposure (Exp 1) and Practice (Exp 2) Trials																			
	Exp 1				Exp 2				Exp 1				Exp 2				Exp 1			
	Instructional Lessons (Ls 1-Ls 5)																			
	Ls 1 - Ls 5				Ls 1 - Ls 5				Ls 1 - Ls 5				Ls 1 - Ls 5				Ls 1 - Ls 5			
	P_1	P_2	P_1	P_2	P_1	P_2	P_1	P_2	P_1	P_2	P_1	P_2	P_1	P_2	P_1	P_2	P_1	P_2	P_1	P_2
S_1																				
.																				
.																				
W-W .																				
.																				
S_{13}																				
S_{14}																				
.																				
.																				
W-P .																				
.																				
S_{27}																				

alternatives were presented with each stimulus word presented in each respective level. With 10 lessons in each level of RA, a total of 30 lessons were administered overall.

Each level of factor RA contains two levels of the third factor, factor Exp. The first level, Exp 1, indicates the initial exposure to the 45 stimulus words, while Exp 2 indicates a second, practice exposure within the same level of RA. Levels of RA represent increased difficulty of the instructional task, while levels of Exp provide initial and practice trials through the materials.

Each level of Exp consists of 5 lessons (Ls 1-5). The Ls factor is a random factor with 5 levels (corresponding to 5 lessons) with the items within each lesson randomized throughout the design; i.e., no two lessons contain the same items and the order of items within lessons is randomized. The order of lessons and items within lessons were completely randomized so as to avoid order effects.

The remaining factor in this design is factor P, representing the first or second pass through the items in each lesson. Each lesson was composed of a set of nine stimulus words which was presented twice. The order of presentation of the nine stimulus words within the first and second passes (P_1 and P_2) was random. In addition, the stimulus words appearing in each lesson in Exp were randomly selected without replacement from the total pool of 45 stimulus words. With nine words in each lesson and 5 lessons in each level of Exp, all 45 stimulus words had been presented twice (P_1 and P_2) in each level of Exp.

The critical dependent variable of this investigation was student performance on the reading posttests, relative to pretest scores. These tests consisted of: a Dolch Word-Recognition test, constructed specifically for this investigation from the 45 stimulus words used in the materials (see Appendices 2 and 3); and the Gates-MacGinitie Primary Reading test, Forms A & B.

In addition to the pre- and posttest data, student performance on each of the thirty instructional lessons was also evaluated. A percent correct performance score was calculated for each pass within each lesson for each student.

Materials

The materials consisted of 30 lessons constructed for this investigation (see Appendix 5 for sample lessons) and an IBM 1500 computer system which presented the lessons and recorded student responses. The lesson materials will be described first.

As noted above, each lesson was composed of 18 items (9 words). Each item consisted of a stimulus word and 2, 3 or 4 response alternatives which were either words or pictures, which was either identical to the stimulus word (in the word-word condition) or corresponded to it (in the word-picture condition). Each item was typed by a teletype terminal. A sample item for the W-W group is given below.

Sample Item for theWord-Word Group

1. HAT	1. COW
	2. HAT
	3. PIG

Since pictures could not easily be represented on the teletype terminals, separate booklets were constructed which provided the picture response alternatives for the word-picture group. These booklets were legal size Xeroxed sheets, coded and matched to the lesson materials and stapled together in the upper left hand corner. The picture alternatives were arranged in a horizontal sequence for each item, for both the 2 and 3 response alternative lessons. Lack of space necessitated a 2 x 2 format of pictures for those items in which four response alternatives were given.

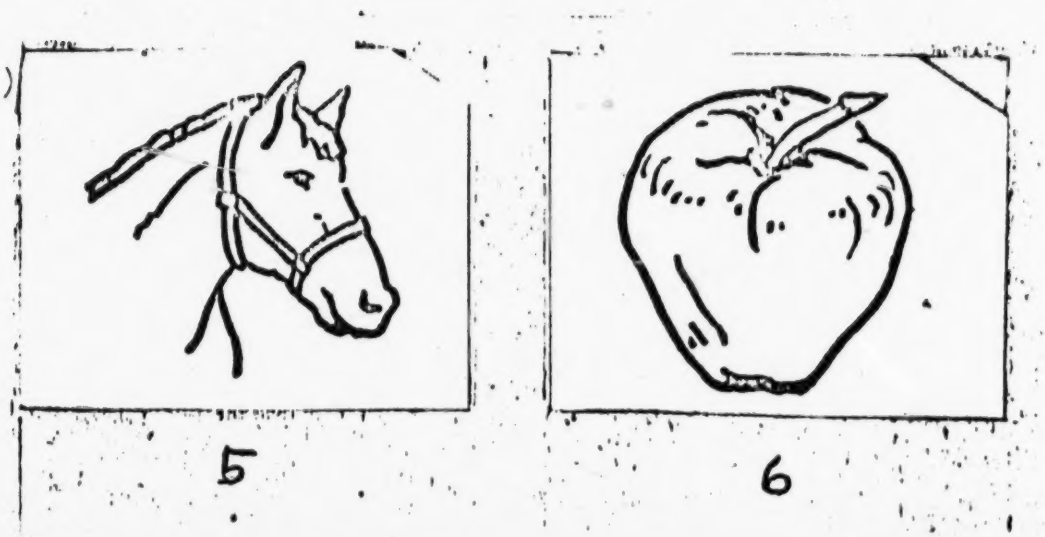
A sample item using only two picture response alternatives is given below.

Sample Item for the Word-Picture Group

Stimulus Word
(Presented on
teletype).

1. horse

Response Alternatives
(Presented in booklets)



In addition to the software described above, an IBM 1500 computer system was utilized. This system consists of an 1800 control processing unit, a 1502 station control, two magnetic tape drives, five disk drives, a card read-punch, a printer, four teletype terminals located in the four EMR classrooms in Wakulla County, and a DEC 680 Data Communications System, which collected and sent data to the remote teletype terminals under the control of a PDP08 computer. The IBM 1500 system uniquely identified and recorded all student responses, as well as compressed, sorted, merged, and summarized this data for analysis. This system was used to present lessons, record responses, provide feedback, process responses, make decisions, collect and organize data.

Procedures and On-Line Task

The word-word and word-picture matching tasks were administered to the students on the teletype terminals. Sign-on procedures were familiar to the students as they had had extensive prior experience on the teletypes. A teacher-aide was available to assist the student in signing on (if he was unable to) and to supply the appropriate booklets. She was instructed, however, to refrain from giving the students feedback during the pre- or posttests and during the instructional lessons. As each item was presented the student was required to press the key on the keyboard which corresponded with the response identifier of the correct matching response. A correct match was followed by four typed asterisks, and then the subsequent item. An incorrect response was followed by a typed "Incorrect, try again." After the first 18 items were presented in each lesson, the percentage of correct responses was typed by the

terminal. A score of 80% or better was followed by a "smiling face," typed by the terminal. If the student received less than 100% on the lesson, the items he missed were presented again.

It should be noted that all analyses are based on a resultant sample of twenty-two students, rather than the original sample of 27. Four students did not complete the instructional materials and another was randomly rejected in order to achieve equal n's.

Pre- and Posttest Results

The critical dependent variable of this investigation was student performance on the Dolch word recognition posttest. The mean scores for both groups on the Dolch and Gates pretests and posttests are presented in Table 4.

TABLE 4.--Mean Group Scores on the Dolch and Gates-MacGinitie Pretests and Dolch Posttest

	PRETESTS		POSTTEST	
	Dolch (percent correct)	Gates (grade equivalent)	Dolch (percent correct)	Gates (grade equivalent)
W-W	27.82%	1.59	48.46%	1.66
W-P	17.27%	1.31	58.72%	1.44

These data are presented in graphic form in Figure 1.

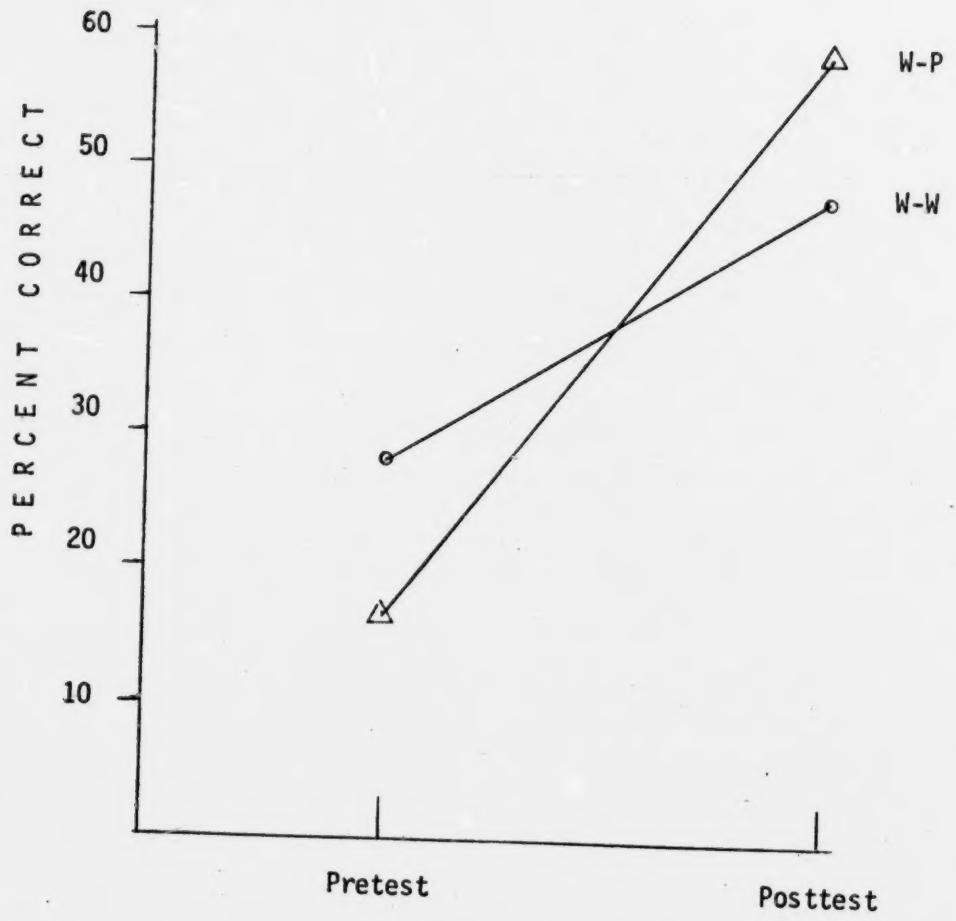


Figure 1.--Mean group performance on Dolch Word Recognition Test

Despite the random assignment of students to groups, statistically significant differences were found on the pretests. The mean percent correct scores for the W-W and W-P groups on the Dolch pretest were 27.82% and 17.27%, respectively ($t = 2.89$, $df = 20$, $p < .05$), while corresponding means on the Gates MacGinitie reading pretest were 1.59 and 1.31 ($t = 2.52$, $df = 20$, $p < .05$) also favoring the W-W group.

An analysis of group differences from the Dolch pre- to posttest, using both the Dolch and Gates pretest scores as covariates, and the posttest as the dependent measure (Cronbach, 1970) indicated a highly significant statistical difference between groups with the W-P group gaining approximately 20 percentage points relative to the W-W group ($F = 9.09$, $df = 1, 18$, $p < .01$). This data is summarized in Table 5.

Table 5.--Group Mean Scores on Dolch Pre- and Posttests; Percent and Number of Words Correct

Group		Pre	Post	Gain
W-W	Percent Correct	27.82%	48.46%	19.64%
	Number Correct	12.15 words	21.60 words	9.45 words
W-P	Percent Correct	17.27%	58.72%	41.45%
	Number correct	7.65 words	26.10 words	18.45 words
Overall	Percent Correct	22.54%	53.59%	31.05%
	Number Correct	10.12 words	24.12 words	14.00 words

In order to assess which of the two covariates contributed most to the reduction in error variance in the ANCOVAR, analyses were run employing each covariate separately. Using the Dolch pretest as a covariate resulted in significant differences between groups on the posttest ($F = 8.54$, $df = 2, 18$, $p < .005$), while covarying on the Gates pretest resulted in a much larger difference ($F = 28.34$, $df = 2, 18$, $p < .001$). This result indicates that equalizing the two groups on standard reading test scores resulted in maximum reduction in error variance, thus gaining maximum sensitivity to the effects of using pictures vs. words.

Group Performance on Instructional Materials

A percent correct score was obtained for each student on each of the two passes through the nine stimulus words (eighteen items) in each lesson. A total of 60 scores was obtained for each student. These data were grouped and analyzed using a 2x3x2x5x2 ANOVA with repeated measures on all but the first factor. The factors included: group effects (the W-W and W-P groups - 2 levels); treatment effects (RA, with 2, 3 or 4 response alternatives - 3 levels); exposure effects (Exp, or first and second exposure - 2 levels); lesson effects (Ls, a random variable based on the order of the lessons - 5 levels); and pass effects (P, first or second pass within each lesson - 2 levels). Only those effects which were found to be statistically significant ($p < .05$) will be presented. Significant main effects will be presented first, followed by interaction effects.

The overall mean percent scores for the W-W and W-P groups were 95% and 89%, respectively. This six percentage point difference was found to

be statistically significant ($F = 20.36$, $df = 1, 20$, $p < .001$). Treatment effects (the number of response alternatives) were also found to be significant ($F = 3.80$, $df = 2, 40$, $p < .05$). Overall mean percent scores for 2, 3 and 4 response alternatives were 93%, 92%, and 89%. Another factor of some interest is the pass variable within each lesson. A statistically significant difference was found between the first and second pass, favoring the first pass ($F = 15.94$, $df = 1, 20$, $p < .001$). The mean scores on first and second passes were 93% and 91%. This finding is only of peripheral interest, however, since a statistically significant group x pass interaction was found ($F = 12.45$, $df = 1, 20$, $p < .005$). The group x pass means were:

	Pass 1	Pass 2
W-W	95%	95%
W-P	91%	87%

Inspection of these means indicates that the W-W group maintained its performance level from the first to the second pass while the W-P group showed a performance decrement of about four percentage points from the first to the second pass. This finding indicates that the main effect due to pass presented above is attributable only to the W-P group, and does not involve the W-W matching task. No other significant interaction effects were found.

It would seem helpful to present findings on student performance through the lessons. Table 6 presents the group x treatment x exposure means, followed by Figure 2 which presents these data graphically.

Table 6.--Group x Treatment x Exposure Means Through Instructional Materials

	Number of Response Alternatives					
	RA 2		RA 3		RA 4	
	First or Second Exposure					
	Exp 1	Exp 2	Exp 1	Exp 2	Exp 1	Exp 2
W-W	97%	97%	96%	97%	92%	91%
W-P	88%	89%	92%	89%	90%	85%

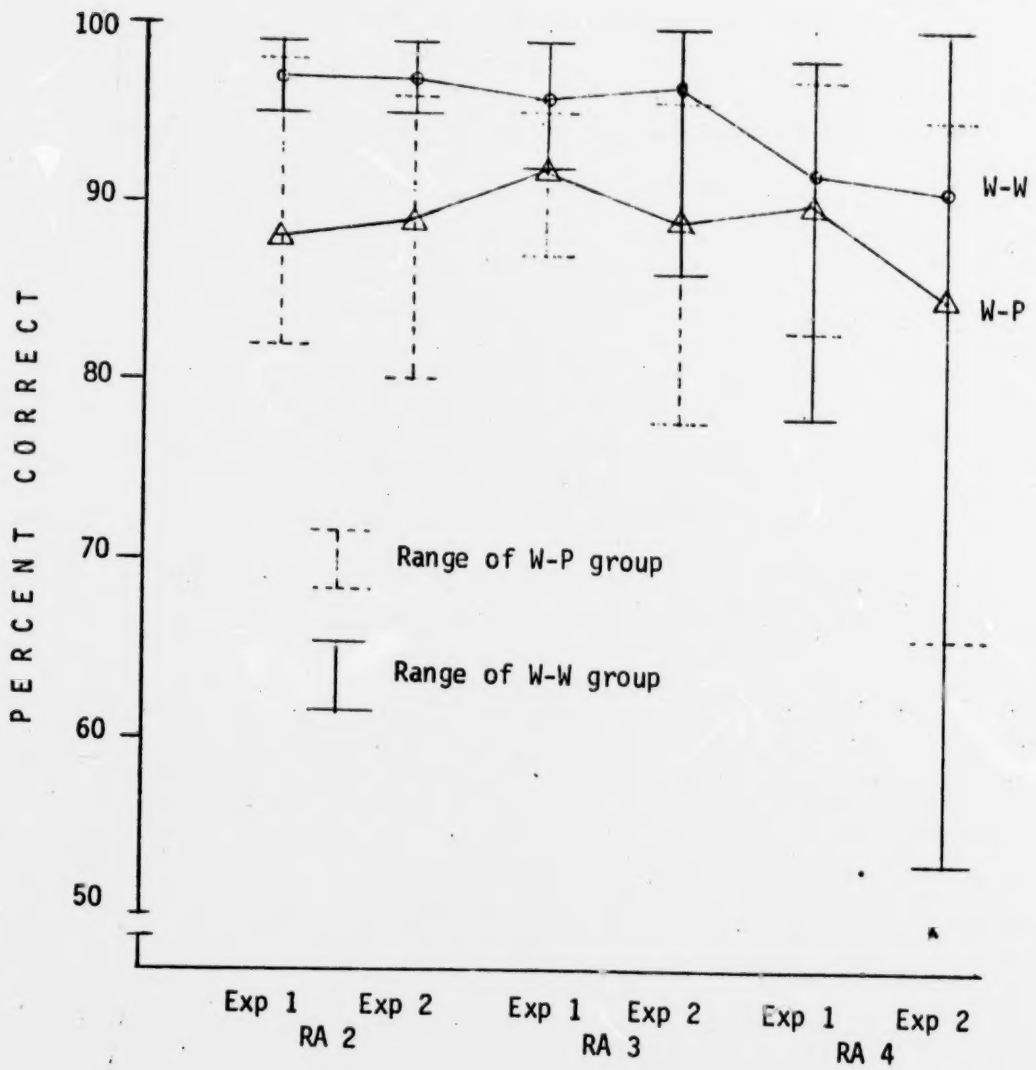


Figure 2.--Mean group performance on instructional materials for two, three, and four response alternatives (RA) and first and second responses (Exp 1 and 2)

Discussion

The results of this study provide clear support for the hypothesis that pictures can aid in the acquisition of a sight vocabulary in rural, EMR children. When the groups were statistically equated using the Gates and Dolch pretest scores as covariates, the effect was strong and consistent over all word groups used in this study. The effect of using pictures as response alternatives was especially marked when the Gates pretest score was the covariate. This finding suggests that the initial reading level score, as measured by the Gates test, was a better predictor of performance than were scores on the word-recognition pretest, even though the groups were significantly different on both tests at the pretest. While the reasons for this difference are not entirely clear, it would appear that the better a child can read (i.e., the higher his Gates score), the more his performance can be expected to improve, since a large portion of the variance could be accounted for by the Gates covariate.

An unexpected finding of this investigation relative to pre-posttests was that both groups significantly improved performance from pre- to post on the Dolch test. The absence of a no-contract control makes evaluation of this finding difficult. It is unclear whether the improvement occurred due to the interaction with the computer (and the feedback capability) or to other less obvious possibilities, such as the on-going instruction in the classrooms.

The results also presented findings relative to group performance on the instructional treatments. One of the expectations prior to the study was that the task assigned to the W-P group would be more difficult than than assigned to the W-W group. That is, matching pictures to a

stimulus word would be more difficult than merely matching words. This was found to be the case, since the W-P group did less well overall than did the W-W- group. However, this statistically significant difference only amounted to about six percentage points and demonstrated that even though the W-P did not do as well, their success rate was still quite high (about 89% correct), an important consideration in designing curriculum materials.

Samuels (1970) pointed out that one of the problems encountered in using pictures is that students fail to attend to relevant stimuli; i.e., both the words and pictures, and argued that pictures tend to interfere with the acquisition of reading skills. This investigation has attempted to control for the attending responses of students and demonstrates that pictures can aid reading acquisition, at least within the constraints of this study. The problem of distraction appears to have been circumvented by the use of a programmed, computerized system. It is not possible, however, to make a direct comparison between the relative effectiveness of this programmed technique and "conventional" classroom instruction, since a noncomputer control group was not available. These findings compare favorably, however, with those of other investigators (Malpass, Hardy, Gilmore, & Williams, 1964).

The present investigation utilized a "shotgun" instructional approach, with feedback, programmed instruction using a linear program, and the CAI hardware used in this study.

Of some importance to practical applications of these findings is the question of whether a modified noncomputerized instructional

approach could be utilized. In other words, can the control gained by using the computer be duplicated in a noncomputerized system without simultaneously resorting to human tutors, an expensive and impractical alternative? Could similar effects be achieved using booklets with delayed, feedback from the teachers or feedback from a list of correct responses, as in some programmed materials?

As some of these questions are resolved it appears that a partial solution to the problems of low ability nonreading students may be achieved. In this case, the acquisition of a basic vocabulary may facilitate the development of reading skills.

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